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Vitamin D Research and Public Health*

By Theodore F. Zucker

Growth of the knowledge about rickets. Extraction of vitamin D from cod-liver oil. Patenting university discoveries. Marketing the new product.

"VITAMIN D" is the name given by McCollum to the constituent of cod-liver oil which prevents or cures rickets.

As was the case with scurvy and vitamin C, the experimental production of the disease marked a turning point in our knowledge. While earlier investigators had procured rickets in animals, it was not until 1921 that a simple method of producing it was discovered, at Johns Hopkins and also at Columbia.

With this experimental aid available, new and striking observations came promptly. We can summarize the direct results of the first few years as follows:

Two types of rat rickets can be produced, one due to low phosphorus and the other to low calcium in the diet. Both probably have analogues in human infants, but the form of infantile rickets commonly found is the low-phosphorus variety. This is accompanied by a low level of inorganic phosphate in the blood. Cod-liver oil prevents or cures all forms of rickets in all species so far examined (rats, mice, chickens, rabbits, pigs, humans, and others). In all cases of low-blood phosphate, cod-liver oil raises the level to normal but not above. In experimentally produced low-phosphate rickets, the addition of phosphate restores the bone to normal, but in spontaneous human rickets, phosphate has no effect.

It was originally held that the curative powers of cod-liver oil were due to its vitamin A content, but this was disproved when McCollum eliminated vitamin A from the oil and still found it efficacious. He then introduced the term "vitamin D."

Another important chapter was soon added to the study of rickets.

* From an address presented before The American Institute of Chemists, New York Chapter, December 16, 1932.

Long before the fact could be experimentally established, at least two separate investigators claimed that light was a decisive factor in rickets; and with experimental animals available, Hess was able to show that certain wavelengths of ultra-violet light are indeed an absolute preventive of rickets. This discovery was followed by another: namely, that these same wavelengths could also impart antirachitic effects when applied to food materials. Later on, Windaus found that the substance activated by ultra-violet light was a nearly universally present fat component, ergosterol. The light action changed the inert substance into the highly physiologically active "irradiated ergosterol," to which the name "vitamin D" was also given.

Present indications based on the work of Steenbock and others are that the two substances having antirachitic activity—one of which occurs naturally in fish oils, the other being formed artificially by exposure to ultra-violet light—are not the same. Whether both substances will continue to go under the name of "vitamin D," we cannot say. So far, the terms *natural* and *artificial* vitamin D have been used to distinguish the two.

WITH so many advances in the study of experimental rickets, interest has been centered in the remarkable effects of cod-liver oil in preventing the disease. Knowing that vitamin A was not responsible, we became interested in an explanation of the cod-liver oil effects, and proceeded to determine what substance in the oil conferred on it the therapeutic properties.

In two of the commonest oils used in medicine, castor oil, and chaulmoogra oil, the medicinal effect lies in the fatty acids; and one theory held that the curative effects of cod-liver oil were due to certain hydroxy fatty acids. We fractionated cod-liver oil and tested the fractions on experimental animals. The fatty acids when even only moderately purified had no activity, while the unsaponifiable fraction showed increasing activity. The cholesterol (another component previously held to be active) was also without effect. We summarized our early observations in 1923, as follows:

> . . . we may say that the antirachitic substance of cod-liver oil can be demonstrated in the ether soluble "unsaponifiable" fraction after alkaline hydrolysis. It is not an organic base of the type described as occurring in cod-liver oil. It is not cholesterol, but similar to cholesterol in its solubilities. The suggestion is made that it may be a sterol related to cholesterol or a cholesterol derivative.

Further elaborating our method for preparing concentrates, we found that the method could be simplified by the initial step of selective extractions of the antirachitic substance by means of such solvents as methyl or ethyl alcohol. In this way the cumbersome extraction of the non-saponifiable fraction was reduced by a good deal. The bulk of the oil remained as oil, and only the alcoholic extract was saponified.

At that time, around 1924, our best results constituted an extract of 1000 times the antirachitic activity of the original oil, but still contained so much of the bad tasting and odorous components that the concentrates, while very readily taken by the experimental animals, were not particularly pleasant for human consumption. These extracts could be judged as to their antirachitic activity by feeding to rats. The question next arose whether in the extract which was antirachitic for rats we could also demonstrate the same full curative effects on infants. This point was successfully demonstrated in the Children's Clinic of Bellevue Hospital and in several health centers.

IT BECAME apparent at this time that we had a useful, possibly a commercially useful process. We approached a drug manufacturing house for help in larger scale operations, with a possible view to manufacturing a useful concentrate. The idea of cod-liver oil activity minus the oil, together with an assay of such activity, was so new that we were treated with frank skepticism. The Council of Pharmacy and Chemistry of the American Medical Association had said not so many years before, as their last dictum on the subject, that any one claiming therapeutic value for cod-liver oil or its extracts outside of the nutritive value of the fats was making fraudulent claims.

But another question was raised. I was asked whether I was willing to patent the process as the discoverers of insulin had done, so as to protect the manufacturer who was willing to put money into developing the product. It was presented to me that a firm taking up such a project would have to expend considerable sums in working out production methods and introducing the product; and after all the hard work had been done, a competitor might calmly ease in and garner profits without material outlay. At the time this seemed to my mind, nurtured in academic good will, rather hard lines. In spite of the example of insulin, I still felt that except in certain cases making application for patents was not done in university circles, at least in this country. When I consulted with colleagues, I encountered the same attitude. However, I wanted my product made useful, and saw, after a while, the full weight of the argument on the side of the manufacturer.

The question was finally decided when it was taken up with President Butler. He indicated that for some time past he had had in mind the creation within the University of some means for meeting such situations. At his behest the Board of Trustees passed a resolution, after due consideration, creating a Board of University Patents, which now functions under the name of University Patents, Incorporated. This Board controls patent rights and copyrights, and administers these for the public good.

We applied for patents in several countries, and the applications were completely assigned to University Patents, Incorporated. It was decided that royalties which might accrue were to be used for further research work within the University.

Negotiations were started with a drug manufacturing house with a view to licensing them under the pending applications; but at this time the enthusiasm created by the extraordinarily interesting results obtained in the prevention and cure of rickets with ultra-violet light and with irradiated products so thoroughly spelled the doom of rickets that very little interest was displayed in our product, with all its bad taste and odor. For a while we all believed that cod-liver oil and its derivatives probably had no future whatever in human medicine. This very condition, however, led to plans ultimately more logical than the original plans looking toward the manufacture by a drug house of a concentrate for medicinal use.

By chance we became acquainted with the representatives of the National Oil Products Company, who deal in oils and technical oil products and who were at that time planning to market cod-liver oil for poultry raisers. They saw a field for our process in supplying oil fortified with concentrate. This plan not only reduced shipping costs of the oil, since a given amount of anti-rachitic potency could be shipped in a fraction of the bulk, but since they deal in oil products they could use the spent oil from our process just as it would have been used otherwise, after extracting from it the concentrate. It is this reclamation process which has led to the comparatively low cost.

License contracts were entered into between University Patents, Incorporated, and the National Oil Products Company. Arrangements, agreeable to both parties, include strict supervision of advertising by the University, and certain regulations with regard to price to the public. The University reserves for itself a low rate of royalty, so as not to raise the price of products worked out in University laboratories; and the University also undertook to enforce through regular assays certain stipulations with regard to the quality of the product, thus safe-

guarding the interests of the public from as many sides as possible.

The project of fortified oil for poultry use soon grew to sizable proportions; and in the course of developing the process to a production scale, and in the experimental work on rats and chickens, a good deal of useful experience was gained. The quality of the product as far as taste and odor were concerned was also markedly improved, and after some time, a stage was reached where a product tasteless enough for human consumption could be made on a factory scale.

The application of our concentrate which we now look upon as the most interesting one is of relatively recent origin. In a recent editorial in the *American Medical Association Journal* in a discussion of rickets and scurvy, we find the following:

> Thanks to an understanding of the origin, prevention, and treatment of the latter disease it has rapidly become eliminated as a serious menace to health and as a prominent factor in the current category of menacing maladies. Unfortunately, this cannot be said with equal assurance in regard to rickets, despite the present-day appreciation of how it can be averted. After several years of vigorous antirachitic propaganda, in which the teachings of the medical profession have been broadcast by all sorts of welfare organizations as well as by the advertisers of curative specifics, rickets remains all too prevalent in many communities."

and further on:

> Obviously, it ought to be of advantage if antirachitic properties could be imparted, without attending deterioration, in a suitable degree to a few foods that enjoy widespread use, particularly in the dietary of childhood. This would avert the uncertainties of sporadic intake of "vitamin D" at periods of crucial importance. Probably the two most universally consumed foods are bread and milk. That is why interest has begun to be centered in these products as means of antirachitic prophylaxis. Milk is of particular interest because of its unrivaled contents of calcium and phosphorus—the adjuvants of a properly planned antirachitic regime.

Methods of adding "vitamin D" to milk, by irradiating milk directly with ultra-violet light or by feeding irradiated yeast to cows, have been developed. If the cost of the milk produced by these methods can be kept low, they will undoubtedly find very wide application. But under present conditions, we have felt justified in attempting the incorporation of our concentrate in milk.

We may say, to begin with, that for the purposes of an anti-rickets campaign a low price of such milk is essential. This milk even on rela-

tively small scale operations can be furnished to the consumer at a price less than the cost of milk plus an equivalent number of antirachitic units in the form of a good grade of assayed cod-liver oil. The sale of such milk has been put into actual operation in Detroit and seems to be finding favor with physicians and with the public health agencies. Doctor Barnes of the Detroit Health Department has conducted a series of tests with this milk on rachitic infants and has found that a quart of the milk having 150 units of "vitamin D" and also amounts corresponding to about 100 units give excellent results in the treatment of rickets. 100 units are the equivalent of about 2 teaspoonfuls of standard cod-liver oil. In 15 rachitic infants he demonstrated that in about two weeks a definite improvement can be noticed both in the X-ray picture of the bone and in the inorganic phosphate level of the blood. In about 40 days a return to normal bone condition and normal blood phosphate was established.

WHILE the incorporation of the concentrate in the milk is an exceedingly simple process, we still have one great difficulty to contend with, namely, that in most states the sale of such milk constitutes illegal adulteration. According to many of the state laws, which were designed to guard the quality and purity of the milk supply, the addition of any foreign substance to milk is looked upon as adulteration. In many states, however, the public health departments, just as the local public health units, have a certain amount of discretionary power—exercised, for instance, in permitting a recent pasteurization process which does not conform to the letter of the law but which is very useful and practical. Pending a change in the law, the health departments can under such conditions give temporary permits for the newer processes. In several states such permission to sell milk with antirachitic concentrate has been given, and in Michigan steps have been taken toward modifying the law. Everyone admits that there is no real objection to such milk, and there are instances where food laws have been modified to accommodate new products when such products have been shown to be safe and useful.

The proper control over the sale of any of the forms of antirachitic milk still remains a problem but will be worked out in due time. The State Department of Health in Michigan has now provided the official machinery by which the city or state milk inspectors can take up samples of antirachitic milk for assay in a designated state laboratory. The reports of such assays are then forwarded to the proper authorities. We believe that any such milk should state on the cap the number of units

of "vitamin D" it contains and that all such milk should be biologically assayed at suitable intervals.

If we want an answer to the question proposed by the writer of the above-mentioned editorials, "Will the current possibilities and enthusiasm buy better health?" there is still a good deal of work to be done in making available and putting within reach of everyone an article of everyday food which will serve as a rickets preventive in infants and a regulator for mineral metabolism in the growing young. We have high hopes that through this modest contribution of ours we can lend a hand to the task which must ultimately be accomplished.

Quotations

DEVELOPMENT of the ethylene gas treatment for hastening the development of color, according to estimates of leaders of the Florida citrus industry, added approximately 50 cents to the market value of each box so treated during the 1930–31 season. This amounts to an increase in value of the Florida orange crop of at least $4,000,000 in this one year. . . .

The citrus by-products industry of California, the most highly developed of its kind in the world, is based solely on research work by the bureau [of Chemistry and Soils]. It has to date yielded growers a total of some $7,000,000 as a result of salvaging thousands of carloads of cull and surplus lemons and oranges.—HENRY G. KNIGHT, *The Scientific Monthly*.

We live in a world of contemporaneous ancestors. All about us we find men who think and react in the manner of our distant forefathers. —HARRY L. HORNING, *The Booster*.

Experiment vs. Experience

By Chandler D. Ingersoll

Two words that have headed two schools of thought. What does each one mean? Etymology as an aid to chemical understanding.

IT IS no witless comment to grammarians that language is meant to convey ideas and that if this is accomplished, the usefulness of language is realized. Like all other dictums, however, the foregoing has often been loaded with a burden of the argument it was never intended to bear. Granted that language has served its purpose if it portrays, no matter how crudely, the idea of the speaker, nevertheless it must use symbols or words having a common meaning in the minds of speaker and auditor.

The meanings of words are important; and in the case of what I shall term "class" words the shading and twisting of meaning, purposely or ignorantly, has raised many an ulcerous sore on an otherwise healthy social derm. Such words as socialist, conservative, heretic, pagan, engineer, politician, and a host of others come to mind as examples of words whose meanings have often enough been loaded with extraneous virtues and vices.

In our own realm of chemistry we are endowed with two words that have unhappily been the cause of much bitterness that might better have been left aside. These two words are *experiment* and *experience*, both exceedingly harmless in appearance and with a common definite Latin root; yet rare is the chemist who has not at one time or another heard artisan or employer deride experiment as a kind of frothy ill-founded hopefulness, or has perhaps himself extolled the progressive spirit embodied in experiment as compared with the ritual of experience. Should a chance reader come short at this point with, "Why no,

I never had any such difficulty," I would commend the adroit path he has steered for himself in his career.

As a matter of simple inquiry, then, let us look at these words and take them apart so that we may ascertain wherein lie these subtle shades and undertones that allow such hidden connotations, and where the entering niche that received the wedges of the riveners of definition. So, down from its shelf comes the almost forgotten Century Dictionary; and we must beg leave to lean on as much authority as we give this time-honored list of words and their sources.

We find that both words break down into a common root, with suffixes as follows:

ex-perire-ment
ex—out of
perire—to go through
ment—suffix commonly hired to make nouns from verbs.

ex-perire-ence
ex—out of
perire—to go through
ence—suffix having equivalent meaning to English ppt. ending *ing* and used on adjectives and nouns formerly adjectives.

Queer, isn't it, that these sore-spots of our diction should have exactly equivalent roots and root meanings. It is difficult to see the exact meaning of the prefix "ex" except as an emphasizer which would translate *expiri* "to go completely through" although this phrase is classifiable with such expressions as "most perfect," "absolutely final," etc.

Vainly has the writer sought authorities on Latin to concur in the theory that the root of *experiment* might be from the present participle form and *experience* from the past participle. It is sufficient to note that the suffix of the latter has, as given above, an equivalence to the English ending *ing*.

A study of these two words would not be complete without a digest of their meanings given in the dictionary source referred to. Deleting therefrom the examples and condensing somewhat, we find the following definitions for each:

EXPERIENCE

1. The state or fact of having made trial or proof or of having acquired knowledge, wisdom, skill, etc., by actual trial or observation; also, the knowledge so acquired; personal and practical acquaintance with anything; experimental cognition or perception.

2. In philosophy, knowledge acquired through external or internal perception; also, the totality of the cognitions given by perception, taken in their connection; all that is perceived, understood, and remembered.

3. That which has been learned, suffered, or done, considered as productive of practical judgment and skill; the sum of practical wisdom taught by all the events, vicissitudes, and observations of one's life, or by any particular class or division of them.

4. An individual or particular instance of trial or observation.

5. An experiment.

6. A fixed mental impression or emotion; specifically, a guiding or controlling religious feeling, as at the time of conversion or resulting from subsequent influence.

EXPERIMENT

1. A trial; a test; specifically, the operation of subjecting objects to certain conditions and observing the result, in order to test some principle or supposition, or to discover something new.

2. A becoming practically acquainted with something; an experience.

The close alliance of the two words is thus further apparent in that under the noun *experience* we find definition No. 5 gives *experiment*, and under the verb *experiment* we find definition No. 3 gives *to experience*.

In the use of words the writer is prone to lean back carefully on their root meanings, yet in this instance he believes present-day technical usage warrants a further interpretation of their meanings in terms of each other, and he makes bold to suggest the following supplementary definitions:

EXPERIENCE: noun—Repetitive experiment on a large or commercial scale, where the conditions of the experiment are given by tradition and on historical knowledge.

EXPERIMENT: noun—Previously planned and intensive experience, usually on a smaller scale than the undertaking or use to which the experience is to be applied.

Why License Chemists?

By Charles E. Mullin

SOME years ago I had a wash-boy in my laboratory who was a first-year student in a night-school chemistry course in one of the well-known Philadelphia institutions. One of his classmates was the son of a physician living in a suburb of Philadelphia. At the end of the first year the physician's son failed to pass his examinations and did not return when classes were resumed in the fall.

Later in the year, my lab boy met the physician's son on Market Street and, in the course of their conversation, was informed that the son was conducting an analytical and consulting laboratory. He told my boy that he got considerable work, especially of the clinical type: urinalyses, milk examinations, etc. His father, the physician, assisted him in obtaining this work.

This "chemist" had a high-school education and one (unsuccessful) year of night-school chemistry. He appeared older than he really was, made a good appearance, used excellent English, and was accepted as a chemist by those desiring the services of a competent analyst. Certainly this is not an isolated case.

Very probably instances such as the above constituted the cause back of a bill introduced into the Pennsylvania legislature about a year later (some ten years ago) which would have required all chemical laboratories handling clinical, food, and certain other analyses or research to work under the direction of a *doctor of medicine*, who would sign all analyses and reports! Perhaps some of the Philadelphia chemists will remember the discussion of this bill in the A.C.S. meetings at that time. It was only through the strenuous efforts of the late Dr. Edgar F. Smith and some other influential chemists, who made many trips to Harrisburg, that the bill was defeated and that Pennsylvania chemists handling work of this type are not today working under the direction of an M.D. A similar bill was introduced in California at about the same time.

Of course these bills were sponsored by the American Medical Association; but they certainly have their foundation in the need for some form of legal control of the practice of chemistry. Chemists owe it to themselves, to their profession, and to the public to place the practice of chemistry under some form of control, preferably under the national government.

Curiosity Instinct

By W. C. Dumas

CURIOSITY, whether in cats or in men, is frequently the basic cause of both feline and human decisions. Like many boys, I had at an early period a great curiosity to learn what was back of the experiments I saw performed in my high-school course. The mechanism or "whyness" of phenomena appealed to me.

After twenty-six years in the practice of chemistry as a profession, I still have as much curiosity to discover "why things work" as I did the day I entered college. I have had only two faults to find with my lot as a practicing consultant. The first is that the profession does not seem remunerative enough for the training and experience required for its successful practice. This condition has been gradually improving in late years, due no doubt to the great publicity given to chemistry in general. Such organizations as The American Institute of Chemists will also be large factors for the establishment of better conditions among chemists.

The second fault mentioned above is that I cannot go after many elusive facts and track them to their lairs. This tracking process is known as research and to me is great sport. But to make commercial practice pay, one cannot be forever exploring by-paths. Yet there is always the desire to know if these roads do not lead into regions much richer than the land lying along the main highway. A road over a hill-top is always alluring, especially if it be a seldom traveled road. To follow facts when they "take off" up such a road as this is still an adventure to me.

SUCH an attitude, I think, is what lends zest to the chemist's work. Every problem can be made a high adventure.

The commercial practitioner or consultant is not permitted such free publication of his work as the pure researcher, due to the conditions under which it is done. Many interesting romances and accounts of how problems were attacked, worked on, and solved lie hidden in the records of commercial laboratories. Some of this work could be published, and the data so presented would be of great value; but when taken out of its proper relation how dry it would seem compared to what it would be if the whole story could be told.

To answer often asked questions, then, I would say: Curiosity about and interest in those things so marvelously fashioned, adjusted, and inter-related by Someone are the reasons why I chose chemistry.

Chemistry at Wisconsin

By H. A. Schuette

How one of the best of the country's chemistry departments grew up in a mid-western college. Present organization and methods. A large graduate school.

ANY account of instruction in chemistry at the University of Wisconsin must include the activities of seven separate departments which, because of common graduate interests, have been organized into a group known as the Chemistry Conference. Its constituent units are the chemistry department and the pharmaceutical chemistry division of the pharmacy department of the College of Letters and Science; the department of agricultural chemistry and the soils division of the department of soils of the College of Agriculture; the departments of physiological chemistry and pharmacology of the School of Medicine; and those sections of the Forest Products Laboratory of the United States Department of Agriculture whose activities pertain to industrial and research chemistry as applied to forest products. Some ninety subjects of instruction are offered in the conference by a combined faculty of approximately forty-four.

Since an account of the activities of all of the foregoing departments and divisions obviously could not be presented with reasonable brevity, it seems best to limit this article to a single department and to one common objective of them all, the training of the graduate student. Seniority and the fact that the instruction in the four basal fields is offered only therein makes the chemistry department the logical choice.

* * * * *

ACCEPTANCE of the State into the Union and the founding of the University of Wisconsin are synonymous dates (1848). In the autumn of the next year, John H. Lathrop, a graduate of Yale, assumed

the chancellorship. Under his administration (1849–58) a faculty of seven was assembled. The last of the chairs to be filled was that of chemistry and natural history, a post to which S. P. Lathrop (M.D. '43, Middlebury), who had been professor of chemistry and natural science in Beloit College since 1849, was appointed in 1854. With the acquisition of Professor Lathrop—and with the assistance of "valuable apparatus" borrowed from Beloit— was begun the first formal instruction in chemistry at the University of Wisconsin. Professor Lathrop's tenure of office was short, however, for he died during the close of the year 1855 without having served twelve months.

Professor Lathrop's successor was Dr. Ezra S. Carr, a graduate of Rensselaer Polytechnic Institute (1838) and of Castleton Medical School, Vt. In the interim between graduation and his removal to Madison he had been a member, in turn, of the faculties of the latter school and of Albany Medical College. Dr. Carr came west upon the solicitation of Chancellor Lathrop and the advice of President Wayland of Albany Medical College, who urged him by all means to go and to devote his energies to making the young University more directly serviceable to the masses of the people and to prevent it "from becoming a hospital for lame ducks." This advice, coupled with a salary adjustment (the maximum for professors at that time was $1000 per annum) and the purchase by the Board of Regents of Carr's private mineral collection for some $1400, a most rash expenditure in view of the pinched finances of the University, apparently won him over to making his new home in Wisconsin. His was now to be the opportunity, as expressed in an earlier wish when a candidate for the same chair in 1854, of opening a "working laboratory in connection with the University, for chemical analysis and for giving students practical instruction" such as they were then receiving at Harvard and Yale.

THE college year was divided into three terms. During the winter term a course of daily lectures upon chemistry and its application to the useful arts was offered. The description of this course suggests an attempt on the part of the administration to answer a vague but insistent feeling abroad that the University was remiss in its obligations to the community in not providing for the "practical" education of its students. The course was designed "to be intelligible and useful not only to the university student, but to teachers, farmers, and all who are engaged in professional and industrial pursuits, and at the same time to point out the leading advantages of scientific applications."

Among the subjects under discussion were heat, light, galvanism,

and electromagnetism, and their applications to heating and ventilating apartments; clothing, photography, electroplating, and telegraphing; the principles of chemical philosophy and their application in the explanation of chemical phenomena; the non-metallic and metallic elements, with their combinations, considered especially with reference to their uses; the value of heating and illuminating materials; the reduction of metals from their ores, their properties and uses; and organic chemistry, including the formation of organic compounds, the chemistry of food, its preparation and preservation, and the processes of tanning, brewing, etc.

In 1859 there was added to the faculty one who had been successful in the British Isles as a teacher of practical chemistry and as an author of textbooks and of whom it was said that he had done more for public sanitary reform and the ventilation of houses than any man up to his time. He was Dr. David Boswell Reid,* a graduate of the University of Edinburgh. Dr. Reid had removed with his family to this country in about 1855 and for a while thereafter gave a series of lectures in the East under the auspices of the Smithsonian Institution and the Lowell Institute of Boston on the progress of architecture in its relation to ventilation and the preservation of health. This activity is what probably brought him to the attention of Dr. Barnard, Chancellor Lathrop's successor in office at Wisconsin, for in his statement of aims and policies to the Board of Regents the new chancellor indicated that one of them was the immediate introduction of practical instruction in the application of science to individual and public health, to agriculture, to architecture, and to other industrial pursuits of the state, and that it would be necessary to secure at least one additional professor for the "proper inauguration of the department of practical science, or a polytechnic school." Upon Chancellor Barnard's recommendation, Dr. Reid was appointed to the professorship of physiology and hygiene and was also named director of the museum of practical science.

Dr. Reid was not to be a member of the faculty for long, however. The financial vicissitudes of the University, and probably too, Chancellor Barnard's inability to serve actively because of ill health, made a reorganization necessary in 1860. The chancellor's resignation was accepted, all chairs were declared vacant, salaries were reduced, and Carr and Reid became candidates for the position previously held by the former. Dr. Carr proved to be the successful candidate; and so died in its infancy the cherished project of Dr. Reid and the administra-

* If this account should come to the attention of any of Dr. Reid's lineal descendants, the author would be grateful for a communication from them.

tion of bringing chemistry before the people of the state through the introduction of this science into the common school curriculum. It is a matter of record, however, that Reid did give extra-mural lectures during his rather short tenure of office "upon scientific subjects in different portions of the State."

Had the choice of the eleven regents been otherwise, it is quite certain that a different story of the early days of chemistry at the University of Wisconsin could be told. Dr. Reid's proven ability as an author, his bent for practical research, and his advanced ideas in education suggest this thought. Dr. Carr's extra-curricular activities were confined to the Wisconsin Geological Survey, of which he was one of the original three commissioners. Except for his inaugural address, which was a plea for a more sympathetic recognition of the sciences, nothing appears to have come from his pen while he was in residence at Wisconsin. His connections with the university were terminated shortly after the school again received a chief executive, Dr. Paul A. Chadbourne.

BETTER days were now (1867) in store for the University. An enlarged public confidence in its success and an almost total change in the temper of the people of the state toward it were reflected in the sympathetic attitude of the legislature with respect to the University's financial needs. This happy turn of events, together with the federal aid made available under the Morrill Act of 1862, permitted a definite program of expansion in which the courses of instruction in the mathematical, the physical, and the natural sciences were to participate.

The prominence given scientific studies seemed to meet with popular favor. A suggestion of this is, in fact, seen in the action of the Board of Visitors who, reporting in 1869 on their observations of the instruction in the natural sciences, averred that the obvious "thoroughness of knowledge and breadth of attainment" of the classes in these subjects "placed them abreast of classes instructed in the older scientific schools of the land." And it was not without some pride that they accepted "as a fact the advance of the institution into the front rank in this department of instruction."

Within the University, during this era of prosperity, the responsibility for developing the course of instruction was divided between two men who were added to its faculty by the new administration. One of these was W. W. Daniells, a graduate of Michigan Agricultural College, whose acquisition by the faculty marked the organization of the department of agriculture. The other was Dr. J. E. Davies, an alumnus of both

Lawrence University and Chicago Medical College. Dr. Davies took the position and title vacated by Dr. Carr. The new position of professor of agriculture was created for Mr. Daniells, who held this title for but one year. It was then enlarged by the addition of the words "analytical chemistry." Professor Davies stepped out of the picture during the first year of Dr. John Bascom's presidency (1874–87) in order to devote himself exclusively to astronomy and physics, and simultaneously Professor Daniells' chair was re-defined, this time to embrace agriculture and chemistry. Finally the word agriculture was dropped from his title in 1880; and by this action was created Wisconsin's first professorship of chemistry, a title significant of the fact that the faculty, which had been heretofore a group of general teachers, was being developed into a body of specialists.

THE story of the development of the instruction in chemistry can now be told in a different tempo. Professor Davies, perhaps not unaware of the progress that Charles W. Eliot had made at Lawrence Scientific School in teaching his students by laboratory exercises, seems to have been the man who introduced this mode of instruction at Wisconsin. The records do not reveal that Professor Carr adopted this innovation during his régime. If he had, such a move would have found space in the catalog.

Laboratory practice in qualitative, blowpipe, and quantitative analysis was now regularly offered for the first time. Instruction in these subjects was the function of the department of agriculture, a unit of the College of Arts. Here, too, a course in organic chemistry, "taught with particular reference to its economic applications," was offered, besides one in agricultural chemistry. The purpose of the latter course was "to give the student a thorough knowledge of the relations of chemistry to agriculture and its application to various operations of the farm." The economic applications of organic chemistry lay in the chemistry of germination, nutrition, vegetable growth, decomposition, fermentation, and saponification; agricultural chemistry covered, among other subjects of study, the composition of soils, manures, and crops, and the chemistry of the dairy.

A rapidly increasing student body and the introduction of chemistry into the two newly organized departments of civil engineering and of mining and metallurgy soon made more laboratory space an imperative necessity. Chemistry did not alone feel the pinch of restricted quarters; the other sciences were also in need of enlarged facilities. Out of this situation came, in a sense, an official recognition of the need

of the sciences. Funds were made available by the state legislature for the erection of a building which was to house the laboratories devoted to the instruction in chemistry, physics, engineering, geology, and zoology. This new building, Science Hall, was characterized by the administration as the largest, most costly (an appropriation of $70,000 had been made for its construction), and most necessary of the entire group on the campus. It was occupied in the fall of 1877. Seven years later fire destroyed it and the "scientific apparatus and collections of inestimable value" which it housed.

On the site of the old a new Science Hall was erected; and for chemistry a separate building, overlooking Lake Mendota and now occupied by the department of chemical engineering, was built and made ready in 1887. The last move (1905) of the chemistry department was to the center unit of the present building which it shares with the pharmacy department. A wing was added to its west side in 1913; and balance was given the front when construction was begun in the summer of 1927 on an L-shaped addition on the east side. This was occupied in 1929. Future plans involve the completion of the west wing and the replacement of the central unit.

With the expansion of the physical plant throughout these years came, of course, the development of a chemistry faculty. The only available record at this writing shows that Professor Daniells was unassisted in his duties until the fall of 1880. Then Magnus Swenson, of evaporator fame and now a participant in major financial and industrial enterprises too numerous to mention, was appointed, with the rank of instructor, to assist him. He was given charge of the laboratory instruction in qualitative analysis. The next year geologist Charles R. Van Hise, the only graduate of the University to rise to the position of its chief executive, was appointed assistant in chemistry and metallurgy to fill the position vacated by Mr. Swenson.

Assistant Professor Van Hise began to devote all his time to his own field in 1885 when Dr. H. W. Hillyer, fresh from Remsen's laboratory, came to Wisconsin to look after the ever-increasing demands of organic chemistry, which now became a separate course of instruction. Part of the catalog's description of this course will bear verbatim reproduction in that it reveals the beginning of regular laboratory instruction in this subject:

> The attempt is not so much to familiarize the student with a large number of substances as to point out on what basis of fact the ideas held as to the nature of the more important compounds and classes of compounds rest. To those who have completed this course an oppor-

tunity is given to study and practice the methods of ultimate organic analysis and to do experimental work in the organic chemical laboratory.

Professor Hillyer was succeeded in 1905 by Dr. W. F. Koelker, a protégé of Emil Fischer, and he, in turn, in 1911 by Professor Richard Fischer, who is the present head of the division of organic chemistry. This division now consists of three of professorial rank, one instructor, and six assistants. It is one of the department's most active divisions, particularly from the standpoint of graduate instruction.

THE division of physical chemistry has a later origin, unless one would choose to read into Professor Carr's 1863–64 lectures on chemical physics the beginnings of this subject. In the year 1892 there was graduated a young man, Louis Kahlenberg, whose excellent scholastic record won for him an appointment to a fellowship in chemistry, the first allotted in this field. His work as a graduate student came to the attention of President C. K. Adams (1892–1901), ever alert to recognize promising talent in the junior members of his teaching force. An appointment as instructor followed. This position Kahlenberg gave up after one year in order to go abroad for graduate study in Ostwald's laboratory. President Adam's disappointment at losing him, together with his proposal of alternate semesters of teaching here and graduate study abroad, is another story, but suffice to relate that a new appointment had apparently been made during his absence, so that at the time of Dr. Kahlenberg's return the departmental budget did not permit of his re-appointment. A position was created for him, however, in the school of pharmacy, whose staff he joined as instructor in pharmaceutical technique and physical chemistry.

It was under these circumstances in the fall of 1895 that regular instruction in physical chemistry was begun at the University of Wisconsin. The following year Dr. Kahlenberg was transferred from pharmacy to chemistry without change in rank but modification of title. Here he rose rapidly and eventually replaced Professor Daniells upon the latter's retirement in 1907. Professor Kahlenberg, upon reorganization of the department in 1919, relinquished some of his activities in physical chemistry in favor of Professor J. H. Mathews, also an alumnus of the University, who after serving for one year (1904–5) as assistant in physical chemistry had returned in 1908 as instructor upon completion of his studies for the doctorate at Harvard.

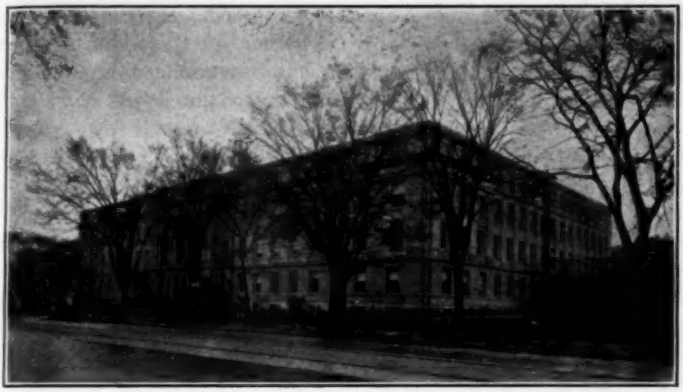
The foundations laid by Professor Kahlenberg have been added to by Dr. Mathews with the result that the division of physical chemistry now numbers three of professorial rank, an instructor, and an assistant.

Colloid chemistry received attention at first in a minor way; but since 1923, when Dr. The Svedberg of Upsala spent a semester and a summer at the University as guest professor of colloid chemistry, it has been increasingly emphasized. The year 1923 also marks the beginning of the colloid symposium, whose inception is due to the foresight of Professor Mathews.

THE metamorphosis of the original instruction in "chemical philosophy" into the present courses in general chemistry, as revealed by a critical perusal of the catalogs since 1854, cannot be gone into in this account. Enough has already been told to provide the background for what follows. In 1900 the late Victor Lenher joined the faculty with the rank of assistant professor of general and theoretical chemistry. He relieved Professor Daniells of the instruction in general chemistry; but when the retirement of the latter brought about a shift in the department, Dr. Lenher was put in charge of the instruction in analytical and inorganic chemistry. Under his guidance this field of instruction was soon developed into an active division, which is now in charge of Professor Norris F. Hall and a staff of five. Professor Kahlenberg at the same time took over the lectures in general chemistry. Dr. J. H. Walton was then added to the staff, with the rank of assistant professor, to supervise the laboratory instruction.

The large increase in the enrollment in elementary chemistry eventually made a further division of duties necessary, with the result that Professor Kahlenberg took over the instruction of the engineering students exclusively. To Professor Walton and staff was given the instruction of all the others. At this writing the instruction in elementary chemistry is done by a staff of five professors, two instructors, and twenty-six assistants.

Once more it becomes necessary to pick up the thread of this account with the activities of Professor Daniells, this time to make reference to a statement in the catalog of nearly fifty years ago which suggests the beginnings of still another field of instruction, that of foods and sanitation. The substance of the statement in question is that students who later expected to go into medicine might avail themselves of special facilities for instruction in urine analysis, the detection of poisons, and the analysis of foods and drugs. From these beginnings there were eventually developed separate courses in those analytical fields which are pertinent to organic chemistry: alkaloidal assay, sanitary water analysis, proximate organic and industrial analyses, and the examination of foods from the standpoint of adulteration.



CHEMISTRY BUILDING AT WISCONSIN

Added interest and impetus was given this type of instruction when Dr. Richard Fischer in 1909, sometime state chemist, became professor of chemistry in the pharmacy department and brought to his new duties a background of practical experience. The writer, then a graduate student, became his assistant in the fall of 1910. He has since assumed charge of these duties of his former chief, who now is devoting his time entirely to other fields of instruction.

SUCH is the story of the development of a department from one-man beginnings with a few students into one which last year enrolled each semester an average of some 2400, pursuing sixty courses of instruction given by a staff of seventy-three men, fourteen of whom are of professorial rank. It is an account which covers, on the part of the parent organization, periods of painful struggling, of hopeful expansion, of enforced retrenchment, of reorganizations, and of rebirth into a going institution. It marks the rise and the decline of the general teacher of chemistry on the faculty of a typical mid-west university and his replacement by the specialist. It is a seventy-seven year record of the introduction of thousands of young men and women to the science of chemistry. Some of these have made of it a "bread-and-butter" activity, others have pursued some phases of it as a required study in a professional course, while for another group it has been a subject of study elected for its cultural value. How these ends may now be attained, both by the undergraduate and the graduate student, is next described.

FOR the undergraduate who wants to specialize in chemistry, two avenues of approach are open. He may elect to follow a prescribed curriculum of study with the object of obtaining a broad foundation in the chemical and related sciences and so enrolls in the course in chemistry, the successful completion of which leads to the degree of bachelor of science (chemistry). If he has no interest in a professional degree, desiring rather greater latitude in the selection of subjects to the end that he may devote some time to other fields of learning, he charts his course toward a bachelor of arts or philosophy degree, and, providing he has absolved at the end of his first two years the University's requirements with respect to the grade point-credit ratio for admission to the junior class, he elects a major in chemistry and is then assigned to an adviser appropriate to the field in which he expects to concentrate. This field of concentration may be one of five: organic, physical, inorganic-analytical, food, and pre-medical.

In addition to the group of subjects which comprises his field of concentration, certain courses outside of it (the total number of credits involved varies between eight and ten) are required. Common to all the fields of concentration are general chemistry, quantitative inorganic chemistry, and a thesis. Mathematical chemistry (a three-credit course), physical chemistry (six to seven credits), and organic chemistry (seven to eight credits) form the required work in the group designated as "outside of field of concentration." Each field is itself identified by those subjects, and allied ones, which characterize it. This set-up of requirements, which replaces an older one, was put into effect at the opening of the current academic year. It permits a student a maximum of fifty credits in chemistry, whereas the former one was forty.

THE course in chemistry does not profess to train chemists for any particular industry, because of the fact that each industry has its special problems and its own methods. The object is rather to train competent chemists for industrial, governmental, and teaching positions. Interwoven with the required subjects of study in the chemical sciences are courses which, it is expected, will give some measure of breadth and round out the student's educational training. Provision is made for elective subjects of study, a requirement being that a certain number of them be other than chemistry, preferably so chosen as to give an educational balance to the student's program.

Three options are offered: a general course, one for industrial chemists, and one in foods and sanitation. It is also possible to obtain specialized training in soil chemistry, agricultural chemistry, or physio-

logical chemistry by following the general option and electing courses in these fields. The three curricula of study have the first year in common. One-year courses in physics and in general, analytical, organic, and physical chemistry are required in all options, as are the equivalent of at least four semesters of German and two of French. Those pursuing the industrial chemist option make contacts with the department of chemical engineering in their senior year. The food chemist option provides for an introduction to plant biology, and combines bacteriology and its practical application to the examination of foods with the chemistry of food composition, manufacture, and analysis.

In each of the foregoing options 130 credits, or ten more than the number requisite for an academic degree, must be absolved. Participation in an extended industrial trip, conducted annually in the spring to the near-by centers of chemical industries in the Middle West, is obligatory. Although it is not specifically required for graduation, the student is urged to devote at least one of his summer vacation periods to practical work in some chemical industry. The first class was graduated from this course in 1909. Its alumni roster now numbers 402. It is a roll from which it cannot be said that the women are conspicuously absent.

* * * * *

GRADUATE instruction is offered at the University of Wisconsin through the graduate school, to which admission is based upon the undergraduate record. Only one of the four fundamental fields may be pursued in any individual's graduate course without prejudice as to the residence requirement. The master's degree may be obtained in two semesters, except that it has now been made possible for the superior student in the college of letters and science under certain conditions to be admitted to the graduate school at the close of his seventh semester as a candidate for this degree in one additional semester.

The doctorate is a research degree. Its acquisition does not mark alone faithful study over any prescribed period, nor does it depend upon any computation of time or any enumeration of courses, although it is obligatory upon the student to pursue a rationally unified course of study in which a principal subject, or major, and one or two subsidiary and cognate branches, or minors, become the points of departure in the planning of a program of scholastic activity. The right to take the final examination is not automatically acquired upon the mere completion of three years of resident study. In short, the granting of this degree "is based essentially upon evidence of general proficiency and of distinctive attainments in a special field, and particularly upon

the recognized power of independent investigation as shown by the production of a thesis embodying original research or creative scholarship." This thesis must be presented with a fair degree of literary skill.

A student is not formally admitted to candidacy for the doctorate until he has absolved the foreign language requirements (a reading knowledge of French and German) of the graduate school, has won his department's recommendation to that effect, and has passed a preliminary qualifying test not less than one academic year in advance of the date when the degree is expected to be conferred.

Every candidate is subject to an oral examination by a committee of five professors upon his thesis and the general field of his major and minor studies. The chemistry department proper prefers to substitute for this oral examination a written one, its so-called "predoctorate." At least one semester, but ordinarily two, before he comes up for his degree, the candidate takes a comprehensive examination, approximately two-thirds of which is devoted to the field of his major and the remainder to material outside his field of specialization. About two half-days are devoted to it. If the results of this examination are satisfactory to all of the professors concerned, the candidate is not required to take other examination in chemistry except in courses and on matters pertaining to his thesis.

The chemistry department graduated its first doctor of philosophy in 1899. The number of such graduates now totals 212. Of this number twenty-seven received this degree before the inception (1914) of the conference.

The Chemicalization of Industry—A Threat and a Promise

IN an address before the Pennsylvania Chapter of the Institute, Williams Haynes, editor of *Chemical Markets*, pointed out some industrial effects of chemistry and called upon chemists to show more interest in the business side of their companies.

"In my student days," Mr. Haynes said, "I never correlated chemistry with economics. This was the experience of most chemists. Today we find economics one of the most popular subjects; and now is a good time for chemists to take economic stock of themselves.

"Two facts must be borne in mind:

"1. Economics seeks to put goods into the hands of the consumer as quickly and as cheaply as possible.

"2. Economics is not a machine or system but is the result of natural development, predicated on two factors: human nature, which does not change very much; and the state of the art, which changes rapidly."

In discussing the present state of the chemical art, Mr. Haynes pointed out that, "Up to the time of the industrial revolution, 1.4 H.P. was available per capita of population. In the United States at the present time, 1500 H.P. per person is utilized.

"The rate of power consumption in industry in America has declined in the past few years. During the eighties, the rate of increase was 5.4% a year, during the nineties 4.9%, and in the next decade 4.3%. The peak was reached in 1909. During the teens the acceleration declined to 3.6%, and still further, to 2.4%, in the twenties. This relative decline may be attributed to improvements in machines and in the application of power.

"Power consumption in the chemical industry has been increasing much more rapidly than in industry as a whole. Between 1920 and 1929 the rate trebled, and the value of chemical products increased correspondingly. The value of the entire industrial production in the United States rose from $34 billion in 1920 to $62 billion in 1928. Chemical products in this period rose from $1.2 billion to $3.3 billion."

From 90 to 95% of the chemical production, Mr. Haynes stated, is used in other industry.

"The use of chemicals in industry," he said, "is vastly different from the use of mechanical materials. Each step in chemical industry

brings about a new chemical, often with industrial wastes and by-products."

ILLUSTRATING other changes in industry due to chemicalization, Mr. Haynes pointed out that Oldham produces more fabrics in one week than could be bleached on all the fields in England, Ireland, and Wales by the old process during a whole year.

"In addition to increasing production, chemical operations lower costs by substituting synthetic for natural products: manufactured for natural solvents, artificial resins for natural gums in lacquers and plastics. The more of these that are produced, the cheaper they become; and in many cases the chemical substitutes are superior to the natural product. The time is not far off when synthetic building materials will replace the common ones of today.

"At the same time, chemicalization of industry means an abnormal rate of obsolescence, which has made chemists far from popular with the bankers. Chemical operation, due to corrosion is also very destructive to plant."

Mr. Haynes summed up the result of chemicalization as "more new industries, more employment, quick capital turnover, cheaper goods, higher wages, and better distribution. There will be a better distribution of wealth in a civilization dominated by chemistry, and hence better opportunity for all.

"The great opportunities for chemists today are in plastics, alloys, and petroleum. But in whatever field they work, chemists should interest themselves in the business side of their industry. They should become acquainted with the demand for and the prices of their products. It is only in this way that they can become executives."

—BENJAMIN LEVITT, *Secretary*

Report of the Unemployment Committee

By M. R. Bhagwat

IN the first three months of 1933 eighty-four chemists and chemical engineers of the metropolitan district registered at the office of the committee.

At the present time direct help is being given to 16 persons. Of these, 7 are working on fundamental research problems in various universities, 4 are in the committee office, and the rest are in public libraries or other city institutions doing some useful work for the community.

Through the courtesy of the Emergency Unemployment Relief Committee, we have been able to obtain food orders for the needy registrants. The same bureau may be able to help with clothing.

PRESENT REGISTRATION

	Registered	*Placements*	
		Temporary	*Permanent*
Class A (neediest)	214	76	18
Class B	212	49	26
Class C	216	33	29
Class D	237	32	37
Total	879	190	110
Range of Previous Salaries			
Over $5000	99	30	17
$3600–5000	152	38	19
$2400–3600	213	57	39
Less than $2400	415	65	35

Unqualified registrants (technicians, pharmacists, etc.) 119

BY-PRODUCTS

Fate, Physics, and Philosophy

THE Cosmologist strode into our laboratory the other day, his air of ill-suppressed excitement showing that some new and daring speculation possessed his brain. The Cosmologist is by profession a physical chemist, a creature of chemokinetics and thermodynamics and other undisciplined mathematics. When judiciously diluted, he is useful; but occasionally he takes the bit into his teeth and starts on a gallop through the stony ground of complex formulas involving negative fractional exponents.

In one of his more lucid intervals the Cosmologist studied a course or two in philosophy, in the vain hope that it might humanize him. He became acquainted with the great theories about the constitution of the universe; and the way he can discourse Anaxagoras, Democritos, and Descartes is, in the language of Browning, the immediate commercial concern of no one. But alas! He never ascended to metaphysics. Instead, he came out a confirmed empiricist. To him Locke, Comte, and J. S. Mill are canonized saints, whose writings are revelation.

This pitiful wreck of what might have been a good intellect worries about the ultimate Wärmetod of the universe, and about the uncomprising consequences of the second law of thermodynamics; and he devotes much of his time to an attempt at rescuing the cosmos from its impending thermodynamic fate. His lucubrations occasionally result in weird ideas that he inflicts upon our patient self, diplomatically referring to what he terms our "eminent critical abilities."

This time he began by deploring entropy and the inevitable dead-level of all force in the universe.

"Do you realize," he lamented, "that the end-product is one solid lump of matter at $-273.1°$ C. which will contain all the worlds and all the suns and stars that now make up our cosmos?"

"And then what?" we asked. There is no use trying to side-track him.

"So on *ad infinitum*, according to the best physics," he declared lugubriously. "Of course, there is the theory of conversion into radiant energy, but a universe full of nothing but radiant energy offers no more hope than the other alternative."

"But where will the degraded energy of the universe go?"

"Radiated off into space," he mourned, "and irrecoverable, at least according to the physicists. But this does not seem logical to me. This view treats energy as having objective existence and of being able to accumulate somewhere outside of matter. The fact is, of course, that what we call energy is never manifested except as it affects the condition of material bodies. Energy is a difference in state between two bodies!"

"Are you arguing that two bodies at the same temperature would contain no heat energy?" we asked.

"Hardly," he beamed, "in the face of your excellent training in physics[1]; but how would you know that the two bodies were at the same temperature?"

We suggested a thermometer. This was a mistake.

"Aha!" he crowed, "now you are introducing a third body which, you imply, is at a different temperature. Don't swear, it's unphilosophical . . . . Now, if energy is of necessity combined with matter . . . . "

"How then can a body radiate heat into empty space where there is no other body to receive the radiation?" we broke in.

"That's exactly the point," he answered joyfully. "It can't; and any theory of the destiny of the universe that implies it is faulty. The idea of a single ultimate mass of matter at absolute zero is indefensible. Such a mass must contain all the energy that ever existed."

"Then it must be in motion," we said.

"If there would be any meaning to the term motion applied to one single body in space. Motion means change of place with reference to some other body taken as standard. With one single body in space we should have no standard for reference, and no demonstrable motion."

"If you destroy motion do you not also destroy time?" we asked, hoping to bring him to an impasse. But he also had read Aristotle.

"Of course," he agreed calmly. "Those concepts simply cancel out. To be sure, I could fall back upon intra-atomic motion, but I don't need it. My idea is that when all energy becomes degraded to a certain point the now recognized laws of equilibrium become inadequate, and the energy actually begins to condense into electrons and protons, absorbing at the same time a tremendous amount of degraded energy and yielding corpuscles at a high intensity level . . . ."

"A pretty speculation," we commented, "but it isn't quite clear to me just what is going to initiate this hypothetical condensation of energy into electrons and protons."

[1] We do not have an "excellent training in physics."

"What initiates the melting of ice at zero, or the boiling of water at 100°? These points of change are due to operation of natural law . . . ."

"But operating always in the direction that diminishes free energy."

"That is true for conditions of comparatively high intensities, but under a uniformly low intensity where further degradation of energy is impossible, free energy is absent. There can be no change to a lower level. All that is possible is either stasis or reversion."

"What are you going to do" we objected "when all energy has been converted into electrons and protons, and you have no further supply to draw upon?"

"No such point will ever be reached," he retorted. "Not that energy is necessarily inexhaustible, but because it is merely an aspect of matter, not an entirely different thing. A physical system, conceivably devoid of energy, consisting of two bodies in space and at absolute zero, will generate energy because the bodies will move toward each other under the influence of gravitation; and when they collide, the temperature of the system will rise according to the well-known formula. . . . "

"You needn't quote it," we conceded. "What would be interesting would be an account of the source of the energy that originally separated your hypothetical bodies!"

"If you wish to abandon your position and fall back upon origins, I'm willing," he agreed. "We know as much in one direction as in the other. In the beginning, minimum entropy. At the end, maximum entropy. Time, then, is a function of increasing entropy . . . . "

The Cosmologist is hopeless.

They Say

"IT IS ONLY the principles of reason which can give to concordant phenomena the validity of laws, and it is only when experiment is directed by these rational principles that it can have any real utility. Reason must approach nature with the view, indeed, of receiving information from it, not, however, in the character of a pupil, who listens to all that his master chooses to tell him, but in that of a judge, who compels the witnesses to reply to those questions which he himself thinks fit to propose. To this single idea must the revolution be ascribed, by which, after groping in the dark for so many centuries, natural science was at length conducted into the path of certain progress."—KANT, "Critique of Pure Reason."

—*The Autocratic Chemist*

BOOK REVIEW

Transactions, American Institute of Chemical Engineers. Vol. XXVII, 1931. *Van Nostrand.* $6.00.

The occupations and earnings of chemical engineering graduates, the relative merits of platinum versus vanadium pentoxide as a catalyst for sulfuric acid manufacture, and the broad subject of stream pollution comprise the greater part of this volume. Other papers include symposia on heat technology and on the corrosion-resisting properties of zirconium alloys.

A survey of the occupations and earnings of 1000 recent chemical engineering graduates from five recognized institutions of learning reveals the existence of a potential demand for about 2000 of these men a year. Today, it is shown, about one-eighth of all engineering graduates have taken chemical engineering, and the saturation point is far from being reached. Five industries: chemicals, petroleum, rubber, iron and steel, and pulp and paper absorb more than half of these graduates. The food, textile, and leather industries absorb only two per cent.

The highly controversial question of the relative merits of platinum and vanadium catalysts for sulfuric acid manufacture is set forth in detail. A great deal of performance data is included: SO_2 concentration in burner gas, consumption of catalyst per per cent conversion, and rate of arsenic poisoning.

One-third of the volume discusses stream pollution and the treatment of industrial wastes. The contributors include, in addition to chemical, civil, and sanitary engineers, a number of government officials, so that the problem is attacked from the legal, economic, and social viewpoints, as well as the technical.

The four papers on heat technology cover such theoretical questions as the effect of tube length on the transfer of heat to oil flowing in pipes, the application of theoretical equations to the drying of solids, and the rate of heat transfer in stream-line flow.

The paper on zirconium alloys reports on studies made to determine the corrosion resistance. A formula is given for a zirconium alloy for service in hydrochloric and sulfuric acids.

INSTITUTE NOTES

OFFICERS

HENRY G. KNIGHT, *President*
Bureau of Chemistry and Soils
Washington, D. C.
M. L. CROSSLEY, *Vice-President*

HOWARD S. NEIMAN, *Secretary*
233 Broadway
New York City
D. P. MORGAN, *Treasurer*

COUNCILORS

Past Presidents	1933	1934	1935
HORACE G. BYERS	HENRY ARNSTEIN	L. V. REDMAN	D. D. JACKSON
M. L. CROSSLEY	FRANK G. BREYER	ALLEN ROGERS	FREDERICK KENNEY
TREAT B. JOHNSON	HERBERT R. MOODY	FREDERICK W. ZONS	A. P. SACHS
F. E. BREITHUT			

CHAPTER REPRESENTATIVES

Philadelphia	*New York*	*Washington*	*Niagara*
W. T. TAGGART	BENJAMIN T. BROOKS	A. L. MEHRING	JOHN F. WILLIAMS

National Council

The one hundredth meeting of the council was held at The Chemists' Club on Thursday, March 16, 1933, with President Henry G. Knight presiding. Prior to the executive meeting of the council, a general meeting was held at which the following members were present in response to invitation:

Messrs. Ross A. Baker, W. J. Baĕza, George Barsky, Joseph F. X. Harold, D. H. Jackson, William L. Prager, Leon V. Quigley, Lloyd Van Doren, and Miss Florence E. Wall.

Also, Messrs. T. A. Wright, Frederick Kenney, F. W. Zerban, H. R. Moody, D. D. Jackson, F. W. Zons, E. L. Gordy, D. P. Morgan, H. G. Knight, H. S. Neiman, W. T. Taggart, and F. E. Breithut.

Plans for the future of the Institute were discussed at length.

At the council meeting following the general meeting the Secretary presented a letter from S. S. Sadtler, president of the Association of Consulting Chemists and Chemical Engineers, calling a conference of a number of associations to discuss the competition of the United States government with private business. The council decided to take no action in this matter.

The Secretary read a letter from A. L. Mehring relative to the reclassification of government chemists; and a letter from Henry Arnstein relative to subjects to be discussed at Institute meetings.

The secretary read a portion of the *Canadian Chemist* for February, 1933, describing the advertising used by the Canadian Institute of Chemistry in interesting manufacturers in that Institute as a source of supply for chemists.

Six new members were elected.

The question of amending that portion of the constitution relating to qualifications for membership was discussed, but no official action was taken.

Council voted to hold the annual meeting in New York City on May 20th. The president appointed D. D. Jackson, Frederick E. Breithut, and Frederick Kenney as a committee in charge of arrangements for the annual meeting.

HOWARD S. NEIMAN,
Secretary.

The one hundred and first meeting of the council was held at The Chemists' Club on Thursday, April 20, 1933, with President Henry G. Knight presiding. The following councilors and officers were present: Messrs. Arnstein, Brooks, Crossley, Jackson, Knight, Morgan, Neiman, and Zons. Mr. E. L. Gordy, editor of THE CHEMIST, was also present.

Dr. Jackson reported on the plans for the annual meeting.

The President appointed Messrs. Crossley, Zons, Neiman, and Morgan as members of the budget committee.

The Secretary reported that he had made arrangements with the management of the Woolworth Building by which the Institute will have the use of the present office on a monthly basis without change in price.

Dr. Crossley reported for the committee on insurance and described in detail a number of suggestions received from insurance companies relative to group insurance for the members of the Institute. Upon motion made and seconded, the subject was referred back to the committee for such further consideration as it may think desirable.

The Secretary reported that the Niagara Chapter now has eighteen members.

A letter from William R. Lynn relative to an industrial alcohol plant was referred to Dr. Arnstein.

Four new members were elected, and two members were raised from Associates to Fellows.

HOWARD S. NEIMAN,
Secretary.

Pennsylvania Chapter

A meeting of the officers and committee chairmen of the chapter was held on April 22nd to discuss plans for the coming year. The following report of the chapter's past activities and future plans was adopted:

As one of its primary activities during the past season the Pennsylvania Chapter definitely set itself to work on the problem of unemployment and relief. To quote from Mr. Cayo's report—"One of our main objectives was the focusing of the attention of the chemists of this metropolitan area on this problem, and we may justly say that we aggressively led the way in this matter." To accomplish this purpose, the various chemical societies joined with the local engineering societies and the Engineers' Club of Philadelphia as a part of the Technical Service Committee. The activities and accomplishments of this committee already have been reported in this publication.

Another accomplishment initiated by this chapter was the formation of a representative council of all groups of chemists and chemical engineers in this area, to meet, discuss, and bring to the attention of their respective groups, questions requiring prompt action on the part of the profession as a whole.

We feel that such cooperation for the common good is a significant and hopeful sign for the future.

During the past year, much attention

was given to a study of the most suitable type of meeting program. Definite suggestions were solicited, and much valuable advice was offered by various members. The officers and program committee feel that while some technical papers are desirable, it would be well to have the majority of the papers of general economic or cultural interest, or concerning professional or community relationships. We feel that the Institute differs essentially in purpose from the American Chemical Society, and that this difference is perhaps not sufficiently emphasized. We therefore propose to bend our every effort during the coming year to enhance the prestige and distinction of chemistry as a profession, and to further this end by drawing attention through dignified publicity to our meetings and our aims.

A strong appeal will be made for more individual effort to build up and strengthen the membership.

The Pennsylvania Chapter also recommends the formation of chapters in the Pittsburgh as well as in the South Jersey or Wilmington areas.

HOWARD STOERTZ,
Reporter.

A meeting of the chapter was held at the Harrison Laboratory on April 4th. The following were unanimously elected as officers for the coming year:

Chairman: WILLIAM STERICKER
Vice-Chairman: HOWARD STOERTZ
Sec.-Treasurer: CHARLES RIVISE
Councilor: W. T. TAGGART

The talk of the evening was delivered by Williams Haynes, editor of *Chemical Markets*. Mr. Haynes' talk is reported in detail elsewhere in this issue of THE CHEMIST. An animated discussion followed.

BENJAMIN LEVITT,
Secretary.

New York Chapter

A meeting of the chapter was held at The Chemists' Club on Friday, April 7th, with Chairman D. D. Jackson presiding. Twenty-five members and guests attended the dinner, and a total of seventy were present for the talk of the evening, by Lawrence W. Bass, F.A.I.C., director of research for the Borden Company.

Dr. Bass spoke on "The Chemist in the Dairy Industry" and illustrated with motion pictures the "Rolactor," the last word in efficiency and sanitation for milking cows. The pictures also showed the new Borden process for packaging ice cream in individual portions, which eliminates the common scoop method of dispensing.

Dr. Bass also discussed, from the chemical point of view, several technical achievements and problems in the field of milk and its products.

Following a lively discussion of the paper, the members interested themselves in the several varieties of dried milk products which Dr. Bass had provided.

New Members

FELLOWS

SAMUEL CABOT, *President,* Samuel Cabot, Inc., 141 Milk Street, Boston, Mass.

GROVES HOWARD CARTLEDGE, *Head of Department of Chemistry,* University of Buffalo, Buffalo, N. Y.

EDWARD MACKAY CHACE, *Senior Chemist,* Laboratory of Fruit and Vegetable Chemistry, U. S. Department of Agriculture, 148 South Mission Road, Los Angeles, Calif.

ERNEST R. HANSON, *Chief Chemist,* Halowax Corporation, 230 Grove Street, Bloomfield, N. J.

Justin F. Wait, *Consulting Chemist and Engineer*, 1520 Jessup Avenue, New York, N. Y.

Associates

Lothiam M. Burgess, *Chemist*, Pilot Chemical Corporation, Box 96, Carlstadt, N. J.

Evangeline F. Deckert, *Research Chemist*, Reed and Carnrick, 155 Van Wagenen Avenue, Jersey City, N. J.

Hyman Joseph Mandel, *Chemist*, The Warner Laboratories, 21 Baldwin Street, Newark N. J.

Alexander Olotka, *Research Chemist*, Robert Rauh, Inc., 480 Frelinghuysen Avenue, Newark, N. J.

Junior

Eleanor F. Bassett, *Assistant Chemist*, Board of Health Laboratory, New Orleans, La.

The following members were raised from the rank of Associate to that of Fellow:

Julius John Gates
Gunther H. Schmitz

Applications for Membership

Fellows

Samuel N. Cummings, *President*, Pylam Products Co., Inc., 799 Greenwich Street, New York, N. Y.

John Mills Haynes, *Lecturer in Pharmacology*, Medical College, State of South Carolina, Charleston, S. C.

Emil Klarmann, *Chief Chemist*, Lehn and Fink, Inc., Bloomfield, N. J.

Howard Ochs, *Chief Chemist*, John P. Carlson, Inc., 420 Carroll Street, Brooklyn, N. Y.

Albin H. Warth, *Chemical Director*, Crown Cork and Seal Co., Eastern Avenue & Kresson Streets, Baltimore, Md.

NEWS

Alan Porter Lee, F.A.I.C., has resigned the editorship of *Oil and Soap* to devote all of his time to his increasing

engineering practice. Mr. Lee's recent work has required that he spend much of his time in Cuba.

Benjamin Levitt, F.A.I.C., chief chemist for Charles W. Young & Company, Philadelphia, delivered a lecture on "The Manufacture of Soaps and Cosmetics" at Beaver College, Jenkintown, Pa., on March 29th. The lecture was illustrated by raw materials and finished products.

A. M. Platow, F.A.I.C., is the author of an article on "Hydrogenated Solvents" in the April issue of *Chemical Markets.*

Alexander Silverman, F.A.I.C., head of the department of chemistry in the University of Pittsburgh, was guest lecturer at a joint meeting of the Physical Science Section of the Thirteenth Ohio State Educational Conference and the Columbus Section of the American Chemical Society, Friday, April 7th, in Columbus, Ohio. He spoke on "Glass as a Factor in Education."

Dr. Silverman also addressed the Kanawha Valley Section of the A.C.S. on April 18th, on "Glass."

Lewis H. Marks, F.A.I.C., has been elected president of The Chemists' Club for the coming year.

F. E. Breithut, F.A.I.C., and **Burke H. Knight,** F.A.I.C., have been elected trustees of The Chemists' Club.

Florence E. Wall, F.A.I.C., presented a paper on "The Historical Respectability of Cosmetics" before the history division of the A.C.S. during the recent meeting in Washington.

Miss Wall addressed the Women's Advertising Club of Providence, R. I., on April 24th, on "Pseudo-Pscience in Advertising," and she is also scheduled to address the Society of Medical Jurisprudence at the New York Academy of Medicine on May 8th, on "Cosmetics—the Outcast of Medical Science."